

**UNEXPLODED ORDNANCE SITE MANAGEMENT MODEL
(UXOSMM)**

**A SOFTWARE TOOL TO MANAGE ORDNANCE AND UXO
ON RANGES AND TRAINING AREAS**

Mr. David Munro
Marine Corps Air Ground Combat Center
Installations and Logistics Directorate
Natural Resources and Environmental Affairs Division
Box 788110
Twentynine Palms, California 92278-8110
(760) 830-7396 ext. 253 munrodt@29palms.usmc.mil

Category: Range Management

The Marine Corps Air Ground Combat Center (MCAGCC), Twentynine Palms California, is the largest Marine Corps “Live-fire and Maneuver” training installation in the free world. Employing nearly 52 million tons of munitions and providing training for over 8,000 Marines annually, MCAGCC has delivered on its promise to provide the United States with effective combat ready personnel while remaining ever vigilant on environmental stewardship.

Encompassing 932 square miles where combined arms exercises (CAXs) are executed in unison, *effective* tracking of munition use became a focus in early 1996. During this time, MCAGCC sought the development of a tracking system that would allow commanders to focus on the mission at hand while simultaneously providing a ‘user-friendly’ integrated system that would produce required record keeping of munition expenditures, without impacting operations.

The Environmental Protection Agency’s (EPA’s) Military Munitions Rule (MR), pending Department of Defense (DoD) Range Rule, and other DoD regulations provided the drive to produce a system to track and record ordnance and unexploded ordnance (UXO) on the ranges and training areas. The focus was on producing a ‘one-stop shop’ for all munitions data requirements to include requisition, reporting, and recording, thus

providing a time and cost savings to MCAGCC. Having a single system accessible through the network at MCAGCC allows range control, explosive ordnance disposal (EOD), and natural resource managers the information necessary to make quantifiable decisions on range clearance, range conservation, operational risk management, and environmental compliance and impacts.

HISTORICAL RANGE CLEARANCE AND MANAGEMENT PROCESS

Since its inception in 1954, MCAGCC has continuously conducted UXO clearance operations. These clearance operations have always been conducted by dedicated active duty Marine Corps EOD Technicians. Since about 1990 range clearance information was fed into an early DBASE® program to record the types and amounts of ordnance removed from the ranges and training areas, but the program could not capture location or spatial data electronically. Thus, when MCAGCC EOD developed plans in the mid 1990's to systematically clear range impact areas the operations were managed and tracked on a (paper) master map.

In addition, units firing ordnance onto the ranges were recording ordnance expenditure data by hand on paper. There was no central repository for collecting and/or maintaining ordnance expenditure and UXO removal data. MCAGCC saw the need for an automated system that could integrate the various range users, while serving as a central repository for collecting, storing, analyzing, and displaying ordnance expenditure and UXO data. The system was named the Unexploded Ordnance Site Management Model (UXOSMM).

UXOSMM DEVELOPMENT PROCESS

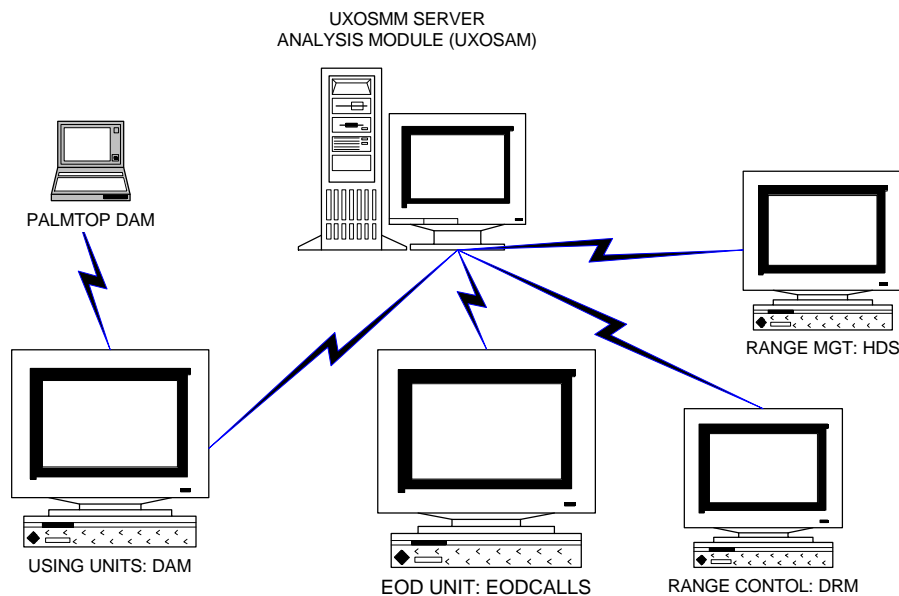
The first step in designing of the UXOSMM ordnance tracking system was to outline and organize data collection requirements for ordnance expenditures, UXO tracking, and UXO removal operations. The Marine Corps sought the Naval Explosive Ordnance Disposal Technology Division (NAVEODTECHDIV), Indian Head, Maryland for assistance in developing the UXOSMM. Existing procedures and data requirements were

evaluated and it was determined that a Geographic Information System (GIS) based approach be used with an integrated database that could be modularized for specific users and implemented across the existing network aboard MCAGCC.

MCAGCC already had an established GIS remote-sensing lab which created and maintained electronic mapping data. A modularized approach was used for the system because of the variety of data and reporting requirements of the different users aboard MCAGCC. The data entry modules were designed around an electronic map interface built by integrating Map Objects® with Visual Basic®. The Map Objects® interface software from Environmental Systems Research Institute, Inc. (ESRI) allows users to capture precise location or spatial data, which is cross-referenced to ordnance expenditure and UXO data in a relational database in a highly accurate and easy to use format.

Data collected from the various input modules throughout the installation are passed over the network to a central server. The server uses ArcInfo® from ESRI to perform the aggregation and analysis of the data from the various modules and displays the results in a format, which can be viewed through the Map Objects® interface. The combination of Map Objects® and ArcInfo® allows non-GIS users to quickly utilize powerful GIS functionality seamlessly in their decision-making process. The system configuration is shown in the figure below with the data input modules feeding into the central server analysis module across the existing network. Those modules that make up the UXOSMM are described below.

UXOSMM CONFIGURATION



Data Acquisition Module (DAM)

The Data Acquisition Module (DAM) collects current ordnance deployment data, which is used by Marine units that deploy ordnance on the ranges and training areas. The DAM module uses pull down menu fields, which accesses a complete Marine Corps ordnance inventory data table to record ordnance expenditures. Users then enter the spatial data associated with the ordnance expenditures through the Map Objects® electronic map interface, which can be set up and tailored by each user with various GIS layers available from the MCAGCC GIS remote-sensing lab including topographic, base boundary, geological, environmental, and target data. Once entered into the system the data from all of the using units is automatically passed to the central UXOSMM server for analysis.

To facilitate record capture in the field, a 32-bit Windows CE Palm Top version of the DAM was designed. The Palm Top DAM is taken to the field to capture ordnance deployment data. Once back from the field the unit connects the Palm Top directly to the desktop and the data is automatically downloaded to the server.

EODCALLS Module

The EODCALLS module utilized by the EOD unit collects information on UXO removed from the ranges and training areas during range clearance operations. The DAM, Historical Data Survey (HDS), and Dud Reporting Modules (DRM) provide summary data through the server analysis module which assists EOD personnel in deciding where and when to conduct range clearance efforts. The program is also used to capture and track information required for EOD management purposes, including EOD equipment usage, demolition explosives utilized, man-hours, and ordnance destroyed. The module passes data automatically to the server and allows the user to query and report on ordnance destroyed, demolition material usage, man-hours, range sweep summary information, and ordnance residue or scrap removed from the ranges and training areas. The EODCALLS module also interfaces with the DRM to provide tracking information on UXO reports.

Historical Data Survey Module (HDS)

The HDS module typically used by Range Management and Range Control personnel captures their years of experience at the installation and allows the input of historical range records to establish a baseline unexploded ordnance concentration level. This module allows input of records from data-calls and archive searches that ascertain when, where, and what types of munitions were fired or employed historically on the installation. EOD historical records are utilized to establish base-line clearance activities aboard the installation and to create a record of routine utilization.

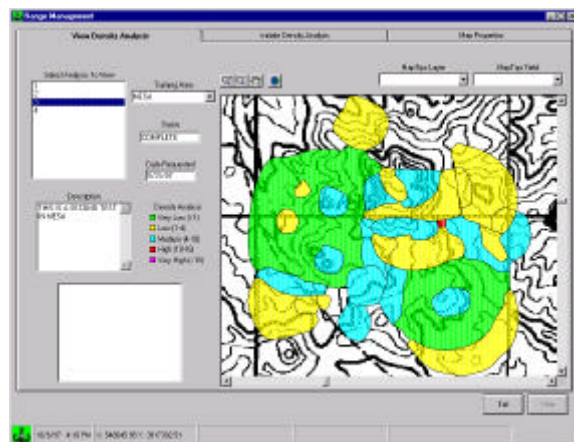
The capabilities of the HDS are virtually unlimited due to the ability to input all levels of historical data along with a corresponding reliability factor. The HDS is used to populate the database with an existing baseline of ordnance, and UXO data that is used to account for historical range usage. Once entered into the HDS, the data is automatically sent to the server.

Dud Reporting Module (DRM)

The DRM is utilized by range control and /or reporting units to record known location of dud fired munitions (UXO) on the ranges and training areas. This information is automatically passed to the server and to EOD for action and/or disposition. If records are recorded off-range, a special immediate notification is sent to EOD and the Natural Resources and Environmental Affairs Division (NREA) because of potential EPA MMR requirements. Records are automatically captured in the UXOSMM on EOD response actions to individual dud records to provide a full account of decisions and actions taken as a result of the report.

UXOSMM Server Analysis Module (UXOSAM)

The UXOSMM UXOSAM takes in data from the four data entry modules for storage, analysis, and display. Using Arc Info® functionality, the UXOSAM performs an analysis of the estimated UXO density on the ranges and training areas (ordnance deployed times specific dud rate minus ordnance removed). The analysis results in a geo-referenced color-coded



map for the installation, which highlights the expected UXO density levels. These spatial files show areas requiring remediation, which can be overlaid with other GIS layers for environmental considerations like the nesting areas of the threatened Desert Tortoise. The density plots can be used to generate geo-referenced queries and reports to provide ordnance types (and amounts) expected to be on each area of the ranges and training areas. The UXO density analysis results are saved as a shape file, which can be viewed in a density viewer module designed with the Map Objects® interface, Arc Info®, Arc View® or almost any other GIS software. The UXO density files are archived so that range managers and regulators can track the conditions of the ranges and training areas

over time, and receive information on the existing conditions of the ranges and training areas with respect to UXO concentrations. “What-if” scenarios for range operations (firing or clearance operations) can be pre-planned to determine their potential impact to the ranges and training areas before they are executed. This functionality allows range managers, and training units to adjust their range operations to minimize the impact to the environment, and allow EOD to plan clearance operations in areas that provide the most benefit.

CURRENT STATUS AND INTERFACE ISSUES

The UXOSMM system is installed and fully functional at MCAGCC. Efforts are under way to take the UXOSMM Marine Corps wide in hopes of providing the entire Marine Corps with a comprehensive standard system used to collect ordnance and UXO data. A master server could be established to link individual base systems together to analyze trends Marine Corps-wide. Tri-Service Spatial Data Standards (TSSDS) for GIS were used where applicable in the design of the system, along with commercially available software packages including Visual Basic® and Access® from Microsoft®. The system can be set-up for other Marine Corps bases and can be adapted for use by other services.

To meet the objective of seamless interfacing in requisitioning, planning, and tracking munitions activities, links or interfaces are planned for the Range Facilities Management Support System (RFMSS) and the Retail Ordnance Logistical Management System (ROLMS) systems. Range Management for range scheduling purposes uses RFMSS and Marine Corps Ammunition Supply Points use ROLMS to track munition shipments and issues. By interfacing, UXOSMM on all, a complete munition tracking solution can be realized. Currently no link or interface exists between RFMSS and ROLMS.

FUTURE ENDEAVORS

In addition to potential Marine Corps wide implementation and interfaces a web-based version of the UXOSMM using Map Objects® Internet server is envisioned to broaden the capabilities and portability of the system.

For more information on the UXOSMM, contact:

Marine Corps Air Ground Combat Center (MCAGCC)
Installation and Logistics Directorate
Natural Resources and Environmental Affairs Division
Box 788110
Twentynine Palms, California 92278-8110
Attn: Dave Munro
(760) 830-7396 ext. 253 e-mail: munrodt@29palms.usmc.mil

or

Naval EOD Technology Division
2008 Stump Neck Rd.
Indian Head, MD 20640
Attn: Mr. Jonathan Sperka Code 50A27
(301) 744-6850 x249 e-mail: sperka@eodpoe2.navsea.navy.mil

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Biography: David Munro is the Military Munitions Program Specialist aboard the Marine Corps Air Ground Center, Twentynine Palms, California. Following ten years of elevated service as an active duty Marine, Mr. Munro assumed his present position under the Natural Resources and Environmental Affairs Division. Seven of his ten years in the United States Marine Corps were spent as an EOD Technician. Mr. Munro obtained his BBA from National University, and is currently pursuing his MBA, specializing in Environmental Management. Mr. Munro resides in Yucca Valley, California with his loving wife Randi and their 5-year-old daughter Danielle.